Preface

Ever since Techenius Otto first described in 1673 that the alkali is neutralized by animal fat, rendering the formation of soap, and thus it contains acidic material. This acidic component became recognized as lipids. Henri Braconnot, around 1815, divided lipids (or graisses) into two categories: (1) suifs, or solid greases, and (2) huiles, or fluid greases or oils. Later in the 18th century, Michel Eugène Chevreul developed a more detailed classification of lipidic materials. French pharmacologist Gabriel Bertrand introduced the word "lipide," which is derived from the Greek word for fat and was unanimously approved by the International Commission of the Société de Chimie Biologique in 1923. Around 1904, several front-line scientists, including Prof. Jacques Loeb, who worked with cells and physiologists, concluded that a thin, oily barrier surrounds cells. Based on capacitance measurements of red blood cell erythrocytes and other experiments, Prof. Evert Gorter and F. Grendel of Leiden University concluded that cell membranes are made of lipid bilayers. After working on these concepts since 1926, finally, in 1935, Hugh Davson and James Danielli proposed the Davson–Danielli model of the plasma membrane of a cell. Prof. J. David Robertson interpreted in 1950, based on electron microscopic images, that the two dark electron-dense bands were the headgroups and associated proteins of two apposed lipid monolayers and advanced the concept of lipid bilayer unit membranes. In 1962, Paul Mueller, Donald Rudin, and others were able to create an artificial bilayer that, like the plasma membranes of the cells, exhibited lateral fluidity, high electrical resistance, and self-healing in response to puncture. In 1964, A. D. Bangham and R. W. Horne showed that lipid bilayers can be constituted simply by exposing a dried lipid to water. In 1972, Singer and Nicholson presented the fluid mosaic theory of lipid membranes. It has been demonstrated that lipid bilayer membranes form spontaneously via self-assembly. Governed by the intermolecular forces, such formation does not require a patterned support structure. The membranes are interfaces of cells that serve as entry and exit controllers and govern many functions of cells. The functional secrets of multicellular organisms are encoded within the molecular composition of their cells, which includes extracellular matrix and fluids. The understanding of constituent lipids, their assembly, and their properties has greatly expanded our understanding of cells and their biological functions. This book is divided into four parts: (1) lipids in different aspects of biology, (2) analytical technologies, (3) lipids in laboratory and investigational medicine, and (4) lipids in clinical medicine. The distinction between the last two aspects of laboratory/investigational and clinical medicine is often diffused, so there are no strict boundaries.

High-throughput approaches have rendered identification and quantification, even spatial localization of these molecular compositions, possibly lipidomics refers to these approaches when applied to lipids. This is an area of emerging new techniques, which are undergoing rapid advancements. The lipids also aggregate in a variety of ways, giving rise to structures of different shapes, referred to as "phases." There are several techniques used to map out which phase is present during perturbations done on the lipid. Various perturbations exist, such as pressure changes, volume changes, pH changes, and temperature changes that render such phase changes. These methods have been developed over the last 4–5 decades and have been less emphasized in this book, but they are nevertheless very important to understanding biological functions and to better understanding diseases. The same amount of insulin in lean type 2 diabetic people leads to a faster drop in blood sugar levels when they undertake light exercise such as brisk walking. The kinetics of blood sugar level drop is steeper if, in addition to brisk walking, these same individuals are also perspiring. These effects are less understood in molecular terms and may well be mediated through lipid phase changes in the cells.

This book provides the audience with valuable insights into various aspects of biology, including aberrations that impact various diseases. Membrane expansion and curvature are increasingly important in processes such as metastasis to axon regeneration, and hence they have been included, but several other chapters in the section on different aspects of biology are related to emerging advances in different aspects of healthcare and medicine. Analytical techniques, particularly the high-throughput approaches and lipidomics technologies, have been emphasized as having been the integration of multiomics data and the application of methodologies to specific areas of biomedical research. Despite our best efforts, some of the emerging technologies and software in the highly niche area in this current book have remained a little less

emphasized than we would ideally like. The sections on lab/investigational medicine and established clinical medicine present somewhat related chapters. The book concludes with a chapter on lipids in large healthcare-related studies. The objective of this chapter is to underscore the importance of accurate and appropriate design in original studies for deriving sound outcomes. The overall outcomes are only as good as the original methods employed for the sound identification of correct lipid species and their quantification.